



## Materials Engineering Branch

### TIP\*



No. 055     Outgassing of Wire Insulation

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At one time, one of the greatest sources of organic contamination on spacecraft has been electrical wire insulation (sheathing). This was a direct result of the large amount of insulated wiring employed in spacecraft assemblies and because much of it was covered with highly volatile polymers such as polyvinylchloride (PVC).

About thirty years ago PVC insulation was prohibited on most spacecraft and a primary substitute recommended was Raychem Specification 44 wire with its duplex sheathing of irradiated polyolefin and polyvinylidene fluoride (Kynar). Outgassing tests revealed that Spec. 44 wire exceeded the maximum allowable values of 1.0% TML and 0.1% CVCMM due to the presence of additives. However, Raychem Spacegrade Spec. 44 wire was also tested and did not exceed the allowable values. Consequently, Spacegrade Spec. 44 was approved for spacecraft use.

Since that time, analyses of cold-finger deposits from spacecraft thermal vacuum tests disclosed a significant amount of a new contaminant, 2-hydroxy-4-methoxy-benzophenone. Subsequent investigations revealed that the Spacegrade Spec. 44 wire gave off this contaminant. Discussions with Raychem verified its use in the composition of the sheathing but they agreed to terminate its use.

Samples of the new sheathing were tested for outgassing and found to be acceptable (0.26% TML, 0.02% CVCMM). Such samples were labeled P/N 44/0411-20-9X but the new sheathing is still produced commercially under the name of Spacegrade Spec. 44.

It should be emphasized that, as of the date of this revision, the preferred wiring insulation is Tefzel Spec 55 (a copolymer of ethylene-tetrafluoroethylene). A strong reason for the desirability of this insulation is that it has the cleanliness characteristics of FEP and TFE without the disadvantage of the cold-flow syndrome exhibited by them. Please see TIP 009 for more information on this subject.